Charlene Spells
Source Assessment Component Manager
U.S.EPA

"The concept of incremental levels of air pollution control/emission reduction techniques (from good housekeeping measures to application of control equipment) as used in air quality management in the United States was a tool for the Russians who were used to thinking of air pollution control in terms of technology only."

Low Cost Measures

Background

The source assessment and the low cost/no cost measures component of RAMP began work in mid-1993. The primary intent of this work was to complete a guidance document for the assessment of enterprises and to recommend low cost control measures which could be implemented quickly that would result in significant reductions in air emissions. In October 1993, nine sources (called enterprises in Russia) were chosen to be evaluated in Volgograd and initial source assessments were conducted. The sources evaluated were chosen based on their contribution to air pollution in Volgograd and their representativeness of industrial sources throughout Russia: cement/concrete production, silica building materials production, primary aluminum production, and secondary steel materials production.

Accomplishments

Particulate matter was the pollutant of choice due to its overwhelming influence on the environment in Volgograd. Using lessons learned in the United States, US EPA officials completed reports for each of the nine sources in May 1994. Each report identified potential no cost/low cost air pollution control measures that could be implemented expeditiously and would result in both visible and measurable air quality improvements in the Volgograd area.

These reports not only provided essential information for the source assessment component of RAMP, but also served as the basis for the emissions inventory and emissions reduction strategy development components of RAMP.

Detailed cost estimate reports for both low cost and traditional control measures were prepared for the Red October Steel Mill, the silica building materials plant and the aluminum plant. (These sources anchored a small study area in the northern region of Volgograd referred to as the "Triangle"). The reports contained cost estimates for several recommended no cost/low cost control measures and several traditional control measures for each of the sources. Schedules for implementation of selected low cost measures were agreed upon in May 1995. The three enterprises originally selected have since implemented RAMP team recommendations.

The first draft of the low cost measures (LCM) guidance document was completed in September 1995. Following favorable evaluation in Volgograd by VESA and in the Moscow Ministry of Environmental Protection and Natural Resources in December 1995, the decision was made to expand this part of the project to the Federation level. SRI AAP, in St. Petersburg, agreed to disseminate applicable sections of the LCM guidance document to the local environmental agencies throughout Russia for review and comment. The "Low Cost Guidance Manual for Selected Industries in Russia" was approved for incorporation into

Russian regulation on July 4, 1996. Conversion of the manual into a format compatible for incorporation into Russian regulations has been completed.

> ...low cost measures are now an important part of the operating plans of many of the enterprises in Volgograd.
>
> Svetlana Kosenkova
> RAMP Co-Manager

All of the low cost measures have a documented net benefit to air quality and have not exacerbated existing problems in other media. For example, "Volgograd Aluminum" is reducing fugitive emissions from plant roads through the use of paving and a regular water spraying program and the Volgograd Tractor Plant has switched to the use of a phenol free water-based method for tempering tractor parts, begun recycling manganese rich casting slag, and implemented a scrap management program for its electric arc furnaces. Further LCMs have been implemented at the "AO Volgograd Drilling Equipment Plant" and other enterprises in Volgograd. LCMs are now routinely included as a part of the enterprises' environmental passports (operating permits).

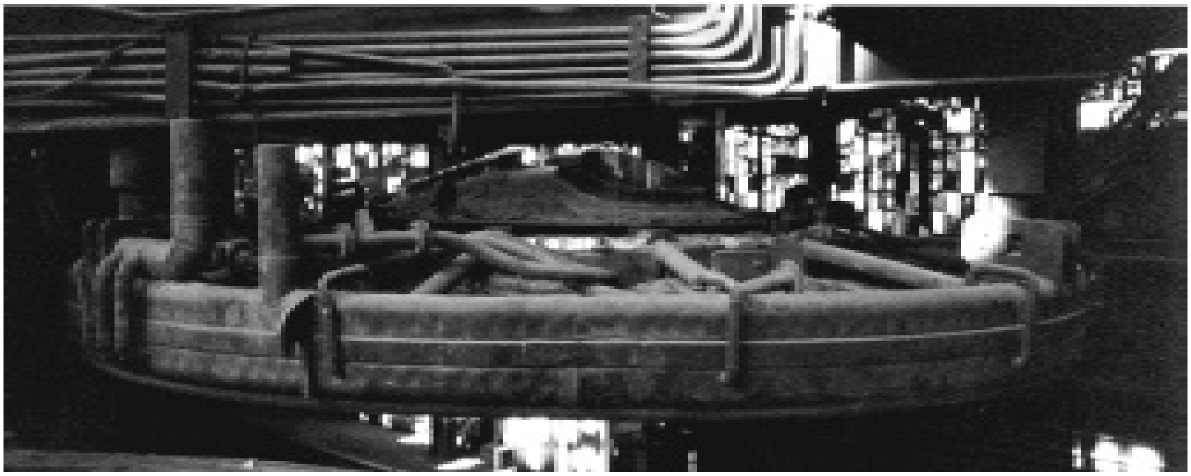
The Red October Steel Mill source assessment report included recommendations for traditional control measures in addition to the no cost/low cost measures. Red October showed significant interest in the application of the precast delta technology for the roofs of their electric arc furnaces (EAFs). A delta is a precast slab with openings for electrodes which can last up to 250 fires of the furnace. It is a substitute for a dome constructed of refractory bricks, currently in use at Red October and throughout Russia, which typically lasts for 20-30 fires. The use of precast deltas would result in a significant reduction in the amount of fugitive emissions released into the atmosphere during the operation of the EAFs.

IMPACT

The source assessments and the implementation of the LCMs resulted in changes to the Russian air quality management system. The guidance manual, "Low Cost Guidance Manual for Selected Industries in Russia," was distributed to affected industries throughout Russia along with a Russian decree requiring its use. Whether or not it is actually being used, or if the decree is being enforced, remains to be determined over the long term. However, the basic goal for the LCM component was targeting categories prevalent throughout the Federation so the adoption of low cost measures could become a common practice. The participation of the SRI AAP in the process was an important "bridge building" step in the overall sustainability of this component, giving the necessary official sanction to these procedures.

Entrance to the Red October Steel Mill, Volgograd Russia

In general, the US approach to air quality issues highlighted a new emphasis for the Russians, who tend to think in terms of examining interactive effects versus discrete elements. Instead of trying to fix the whole enterprise in a single pass, the Russians have now focused their efforts in phases and then apply a simple methodology to identify control options.



Top of electric arc furnace at the Red October Steel Mill to be replaced by a precast delta

Documentation

Volgograd Source Assessments and Emission Inventory Reports for:

Silica Building Materials	Red October Steel Mill
Aluminum Plant	Furniture Factory
Oil Refinery	Caustic Plant
Casting and Mechanical Plant (cement/concrete)	Engine Works Plant

Integrated Works of Industrial Structures Plant (secondary steel manufacturing)

"Low Cost Measures Report on Emission Reductions and Cost Analysis for Silica Building Materials Plant, Red October Steel Mill and Volgograd Aluminum Plant"

"Traditional Measures Report on Emission Reductions and Cost Analysis for Silica Building Materials Plant, Red October Steel Mill and Volgograd Aluminum Plant"

Inside of an electric arc furnace at the Red October Steel Mill, Volgograd, Russia

"Low Cost Guidance Manual for Selected Industries in Russia"

1. Hot Mix Asphalt
2. Cement Concrete Industry
3. Silica Brick
4. Primary Aluminum Production
5. Secondary Steel Manufacturing
6. Volatile Organic Compounds

Principals Involved in LCM Component

Boris Arefiev, VESA
John Jeffery, SAIC
Tatiana Koneva, Red October
Oleg Kreitchi, VESA
Boris Masalov, Engine Works
Thompson Pace, US EPA
Mark Saeger, SAIC
Charlene Spells, US EPA
Anna Trashilova, IA
Yuri Voronkov, VESA
Ed Wojciechowski, US EPA

Willis Beal
Project Manager, 1995 - 1999
U.S.EPA

> ...introducing American low cost measures never before used in Russia is a real tribute to RAMP; the furtherance of precast as an accepted LCM in Russia will be both a challenge and opportunity.

BACKGROUND

During site visits to the Red October Steel Mill in October 1993-94, the 125 ton electric arc furnace (EAF) was identified as a significant source of emissions. Emissions were escaping through the electrode porthole during the melting process and then through the electric arc furnace shop roof vents, directly to ambient air. The quantity of emissions was related to the quality of the scrap that was being charged and the size of the electrode holes on the furnace rooftop. When these electrodes vibrated excessively, they would bump into the refractory brick on the roof, chipping away at it and further enlarging the holes. The bigger the hole, the greater the fugitive emissions that escaped uncontrolled through the roof vents.

Under the RAMP low cost measures component, an extensive investigation of appropriate control alternatives resulted in the recommendation of precast delta technology. This precast material is castable so it is all in one piece, rather than made brick by brick. The key was to determine whether precast technology would be applicable to the Red October electric arc furnace(s).

In March 1996, twenty-three Russian members of the RAMP team visited Research Triangle Park, North Carolina, as part of a week-long training and strategy conference. One of the participants was the technical director of Red October Steel in Volgograd. A meeting was arranged in Pittsburgh, Pennsylvania, with the technical contact at AP Green (AMTEC), the American manufacturer of precast deltas, to discuss the precast delta and its applicability to the Red October Steel Mill. While in Pittsburgh, they visited Republic Steel and observed installed precast deltas, and then traveled to Middletown, Ohio, to observe the actual fabrication.

Arrangements were made for the technical manager of Red October to return to the US and meet with AP Green to design a delta for a 125 ton furnace located in the Red October Steel Mill. Upon completion of these blueprints, a mold was fabricated and the precast delta was manufactured in Pittsburgh and shipped to Russia. This effort was intended to be very simple: ship the delta to Russia, transport it from St. Petersburg to Volgograd, and have US experts travel to Volgograd and assist the Russians with the installation of the precast delta. Unfortunately, problems with customs delayed the process for nearly eighteen months.

INSTALLATION

The RAMP team traveled to Volgograd for the installation of the delta in March 1999. The team removed the delta from its mold and centered it on a water-cooled ring that had previously been pressurized and placed on the extreme outside diameter of a brick mound.

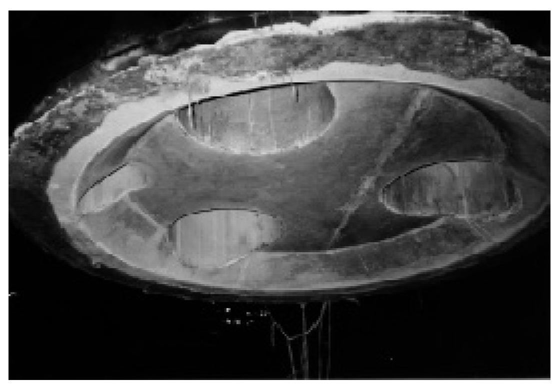
The delta and the water-cooled ring were marked and separated. The ring was then removed from the brick mound and placed on a flat section of the floor. The delta was put inside the water-cooled ring and the two marks aligned. The Russian factory workers then went around the circumference of the delta with a rope to even up the spaces between the delta and the ring and to center it.

The next step was to physically make the field pour for filling the space between the delta and the water-cooled ring. Once the pour was completed, the delta was covered entirely with an asbestos blanket. The following day, the asbestos blanket was removed in order to insert a gas pipe underneath the delta. The entire unit was then covered with the asbestos blanket. After determining that water was not escaping, the delta was aligned onto the electric furnace.

U.S. fabricated delta in casting mold at the Red October Steel Mill.

The delta is removed from the casting mold.

Water-cooled ring prepared for delta installation.



Delta is positioned in the water-cooled ring after pouring of thermal-resistant concrete between the delta and the ring.

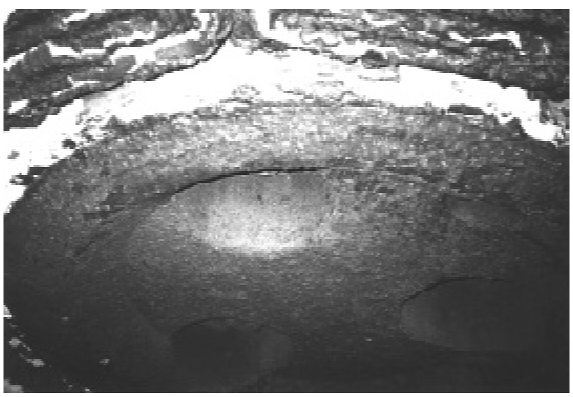
RESULTS

The installation of the precast delta was successful. The visible emissions, which were approximately 30-40% with the old roof design, were reduced to zero. This fact alone is evidence that the application of this low cost measure was effective. With the visible emissions reduced to zero, most of the emissions are being evacuated through the fourth hole and ducted to the control cleaning device, two sets of Venturi scrubbers in series. It was noted upon leaving the EAF shop that the emissions through the stack appear

Delta and ring are ready for installation on the EAF.

Delta has been installed on the EAF. Compressed rings are visible. Electrodes go through compression rings.

to have increased. Initially this may seem like a disadvantage, but actually it is a positive benefit to the environment. It verified that more of the emissions from the electric arc furnace are making their way to the control device, which would later be calibrated to handle their increased level.



Delta after the first heat. Deposition of metal oxides is visible on the lower surface.

IMPACT

From a qualitative standpoint, the installation of the precast delta on the electric arc furnace has been significant. A preliminary indication to support that success was the visible emissions in the shop from the EAFs were immediately eliminated and the visible emissions out of the stack had increased. The delta minimized the space around the electrode holes, so that more of the emissions were captured and drawn off through the fourth hole and directed to the air pollution control device. In the past, the emissions were able to escape through unusually large electrode holes, bypassing the control device altogether and escaping to the atmosphere through the vents in the electric arc furnace shop.

The Russians adopted US methods of measuring the furnace emissions before and after installation of the delta. There are three phases of testing, the melting period, the oxidation period, and the reduction period. The testing with the old roof during the melting period for particulate matter resulted in a mass emission rate of 20 grams/second. After the installation of the delta, the melting period yielded emissions at 109 grams/second. There are no visible fugitive emissions; however, it appears there are five times the organized emissions, which can be captured by traditional control measures.

The important initial result is that the fugitive emissions after the installation of the delta were not visible. Once the operation of the system has been optimized and the conditions stabilized, the Russian operators and technicians will be able to get a better “after delta average,” and from there make better comparisons and draw stronger conclusions.

Although the Volgograd specialists are still completing that study, it appears clear that the precast delta is a viable strategy for Russian EAFs — reducing emissions, conserving energy and increasing operating time. The Russian partners plan to take the results of this test and move toward disseminating the technology throughout Russia. The success of the precast delta technology is one of the major achievements of the RAMP project.

Principals Involved in Precast Delta Component

Viktor Gorokhov, SAIC
Yuri Kazakov, US AID
Viktor Kirpichenko, Red October
Semyon Kliot, Red October
Fred Renner, SAIC
S. Rogov, Red October
A. Rybkin, Red October
Lee Whaley, REFCO
Alex Wilkie, Harbison-Walker